

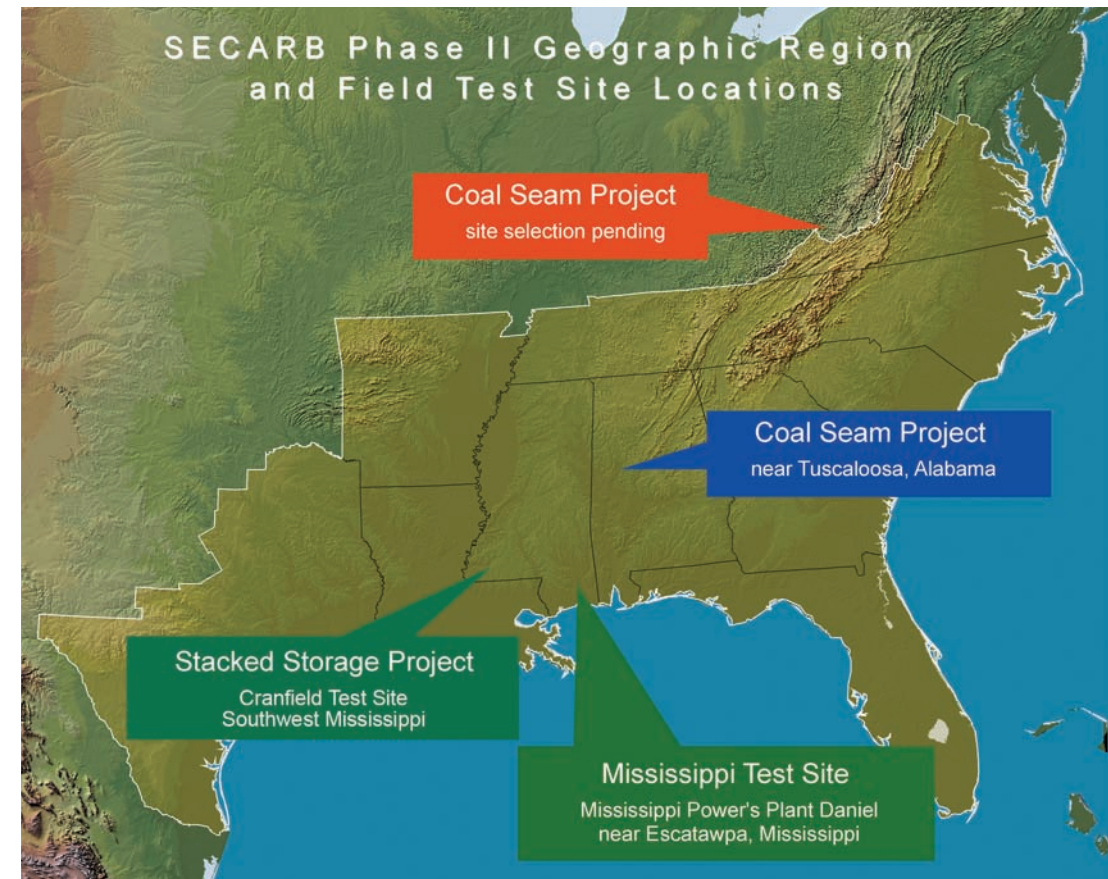
Southeast Regional Carbon Sequestration Partnership

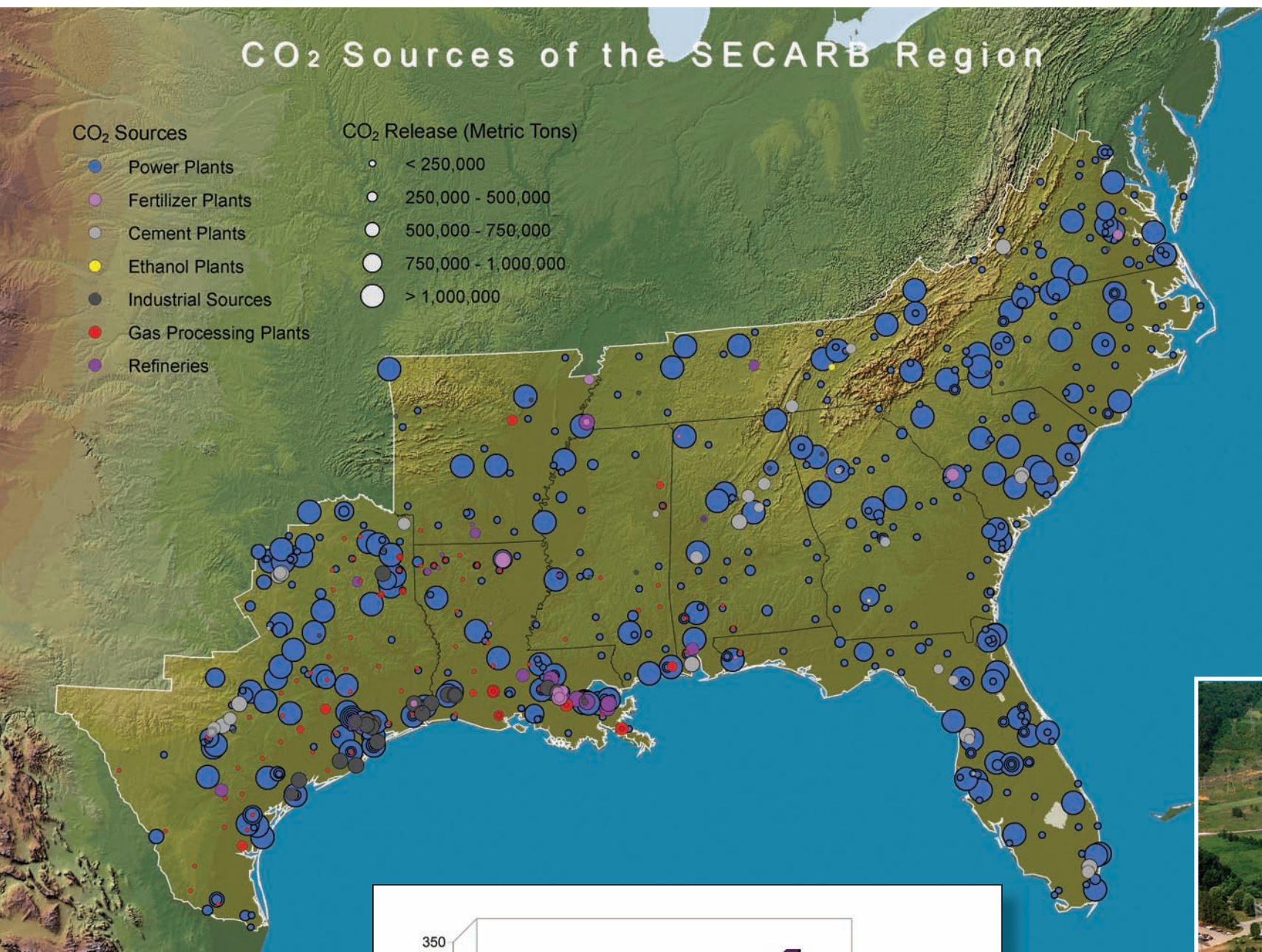
The Southeast Regional Carbon Sequestration Partnership (SECARB), encompasses an 11 state region including the states of Alabama, Arkansas, Florida, Georgia, Louisiana, Mississippi, North Carolina, South Carolina, Tennessee, Texas, and Virginia. Additionally, Kentucky and West Virginia are collaborating with the Appalachian Coal Seam Project.

SECARB efforts focus on four diverse field tests comprised of phases aligned with project definition, design, implementation, operations, and closeout/reporting; continued characterization of regional sequestration opportunities; and cross-cutting services in education and outreach, regulatory and permitting, monitoring, measurement and verification, geographical information systems, and project management. SECARB will develop best-practices manuals to support regional transferability and wide-scale deployment. The field tests include the following

- Two Coal Seam Projects for validation of sequestration opportunities in the Black Warrior Basin Central and the Appalachian Basin, where CO₂ ECBM recovery operations can add economic value and where unmineable coals can provide sequestration opportunities;
- The Mississippi test site will focus on validating geologic storage in a deep, saline reservoir. The test will be conducted at Mississippi Power Company's Victor J. Daniel, Jr. power plant, a coal-fired facility near Escatawpa, Mississippi; and
- A Gulf Coast Stacked Storage Project that builds upon the Gulf Coast Carbon Center of The University of Texas Bureau of Economic Geology's experience managing the Frio Basin Project and investigates a stacked sequence of hydrocarbon and brine reservoir intervals, where EOR with CO₂ can serve as an economic driver in establishing the CO₂ infrastructure for transportation and storage into underlying deep saline formations.

Each field team has assumed responsibility for the technical scope of work, local education and outreach, permitting, MM&V and maintaining the validation test's schedule and budget. In addition, a task has been dedicated to integrating field data and filling gaps in regional characterization data sets. Data and tools developed in this task will be incorporated into a relational database and GIS.



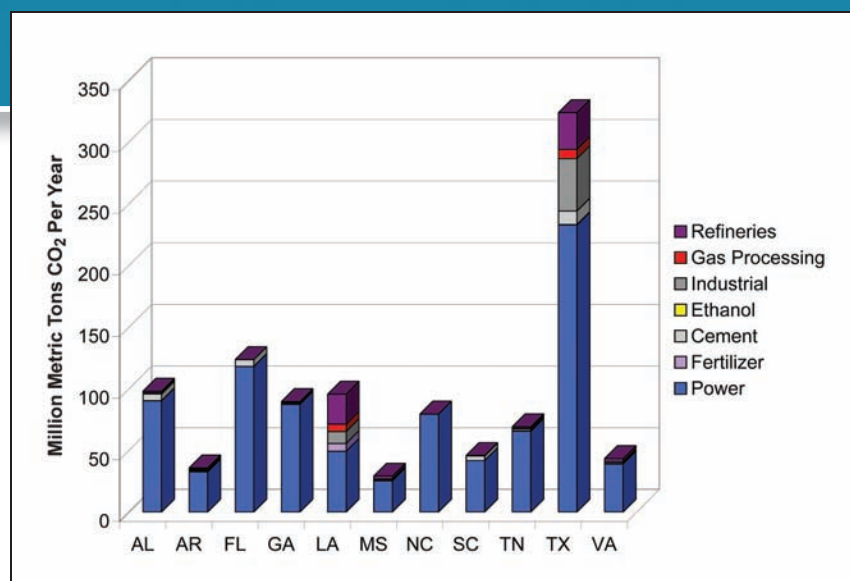


SECARB CO₂ Sources

More than 800 large, stationary sources of CO₂ in the SECARB Region are potential targets for carbon sequestration. Their total annual emissions are estimated at just over 1 billion metric tons (1.1 billion tons) of CO₂. Fossil-fueled (coal, gas, oil) power plants are the largest contributors, accounting for approximately 85 percent of the total CO₂ emissions.

The SECARB Region is also host to a number of nonpower-related stationary sources of CO₂. These include, in descending order of contribution of CO₂, refineries, ethylene plants, cement plants, gas processing plants, ammonia plants, iron and steel plants, and ethylene oxide plants.

CO₂ emissions for the SECARB Region are displayed in the chart (right) and map (above) by location, source type, and quantity.



Colbert coal-fired power plant, Alabama, emits around 8 million metric tons (9 million tons) of CO₂ per year (source: Tennessee Valley Authority).

SECARB Oil and Gas Reservoirs

The SECARB Region, particularly Louisiana and eastern Texas, is an area with a rich history of oil and gas production. As such, considerable information exists on the geological settings and reservoir properties of these potential CO₂ storage sites.

The Region has produced nearly 7 billion m³ (44 billion barrels) of oil and nearly 9.4 trillion m³ (332 trillion ft³) of natural gas. Application of CO₂ EOR could add 2.1 billion m³ (13 billion barrels) of oil to these totals. These oil and gas reservoirs provide opportunities for storing CO₂, assuming that the water and low pressure gas occupying this pore space can be efficiently displaced with injected CO₂.

The CO₂ storage capacity offered by the oil and gas fields in the SECARB Region is nearly 31 billion metric tons (34 billion tons). These oil and gas fields can provide excellent sites for securely storing CO₂, given the presence of a porous and permeable reservoir overlain by a competent caprock.

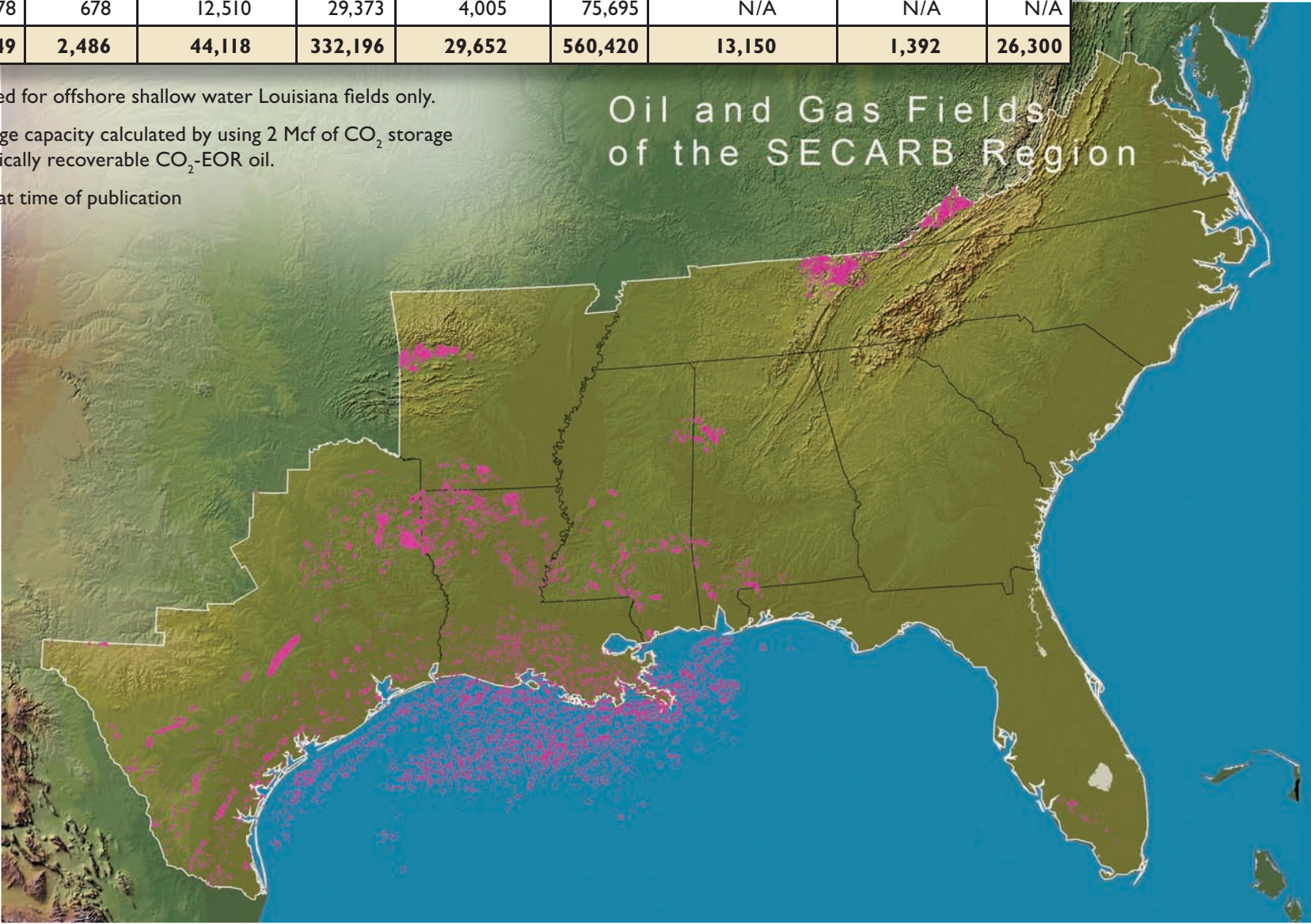
Thus, the SECARB Region offers the potential for integrated application of CO₂ EOR and CO₂ sequestration, helping to accelerate the storage of CO₂ in the Region.

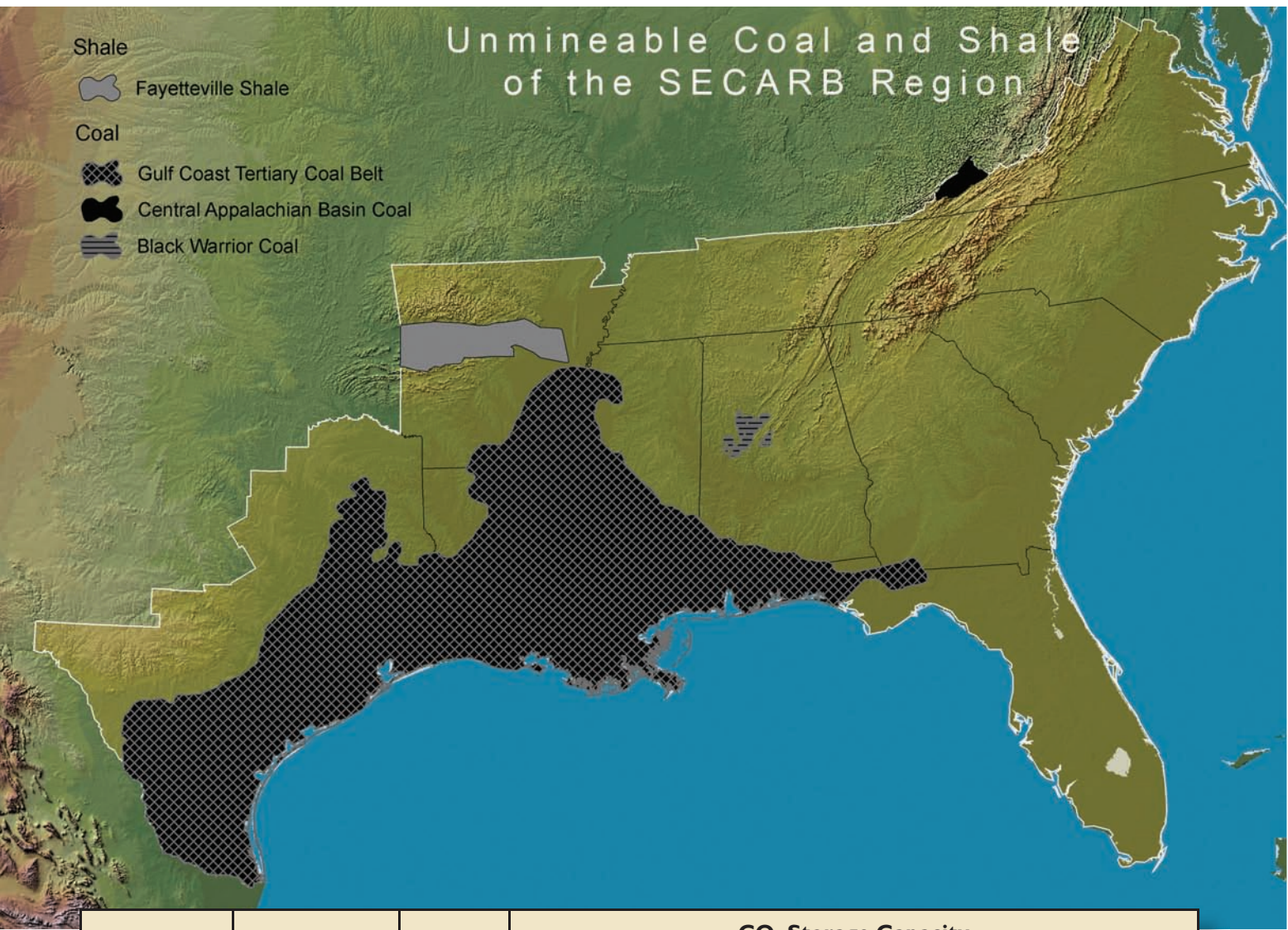
State	Number of Fields		Cumulative Recovery		Conventional CO ₂ Storage Capacity		Technically Recoverable Oil from CO ₂ -EOR	Additional CO ₂ Storage Capacity**	
	Total	Assessed	Oil (Million Bbls)	Gas (Bcf)	(Million Metric Tons)	(Bcf)	(Million Bbls)	(Million Metric Tons)	(Bcf)
Alabama	133	63	622	1,856	344	6,504	410	43	820
Florida	23	8	556	0	109	2,061	180	19	360
Mississippi	110	101	1,346	5,300	399	7,549	850	90	1,700
Louisiana	964	331	11,847	117,697	6,781	128,153	5,480	580	10,960
Arkansas	42	42	1,394	1,415	250	4,728	340	36	680
Virginia	49	49	–	89	10	180	–	–	–
Tennessee	213	213	–	–	–	–	–	–	–
Federal Offshore	1,337	1,001	15,843	176,466	17,754	335,550	5890*	623	11,780
Texas	678	678	12,510	29,373	4,005	75,695	N/A	N/A	N/A
TOTAL	3,549	2,486	44,118	332,196	29,652	560,420	13,150	1,392	26,300

* CO₂-EOR assessed for offshore shallow water Louisiana fields only.

** Additional storage capacity calculated by using 2 Mcf of CO₂ storage per barrel of technically recoverable CO₂-EOR oil.

N/A Not available at time of publication





SECARB Coal Seams and Gas Shales

Three significant coal basins and one gas shale basin have been appraised within the SECARB Region. The first of the coal basins, the Virginia portion of the Central Appalachian Basin, may hold from 308–818 million metric tons (340–902 million tons) of CO₂ storage capacity. The second coal basin, the Black Warrior Basin in Alabama and Mississippi, has a potential storage capacity of 467 million metric tons (515 million tons) of CO₂. The third coal basin, the areally extensive Gulf Coast Tertiary Coal Belt, may hold from 43–61 billion metric tons (47–67 billion tons) of CO₂. However, additional information is needed to more rigorously quantify this large potential CO₂ storage option.

The one gas shale basin in this Region appraised to date, the Fayetteville Shale in the Arkoma Basin of Arkansas and Oklahoma, may hold 14–20 billion metric tons (15–22 billion tons) of CO₂ storage capacity. (The large Barnett Shale gas play in the Fort Worth Basin has yet to be appraised.)

Considerable technical uncertainty surrounds the efficient utilization of the large, available CO₂ storage capacity offered by coal seams and gas shales, particularly with respect to CO₂ injectivity and injection well requirements. The two SECARB field tests, in the Central Appalachian and the Warrior basins, will help reduce this uncertainty.

Basin	Status of Development	Area (Square Miles)	CO ₂ Storage Capacity			
			Billion Cubic Feet (Bcf)		Million Metric Tons	
			High Estimate P(15)	Low Estimate P(85)	High Estimate P(15)	Low Estimate P(85)
COAL						
Central Appalachian	Mature	1,269	15,460	5,821	818	308
Black Warrior	Mature	1,305	8,826		467	
Gulf Coast Tertiary Coal Belt	Undeveloped	160,317	1,148,364	803,817	60,760	42,530
SHALE						
Arkoma (Fayetteville)	Emerging	8,610	379,890	266,490	20,100	14,100

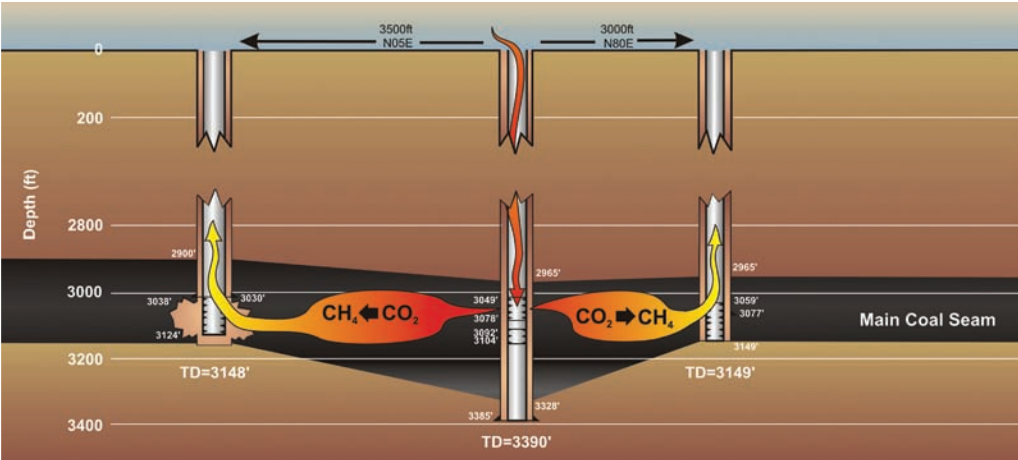


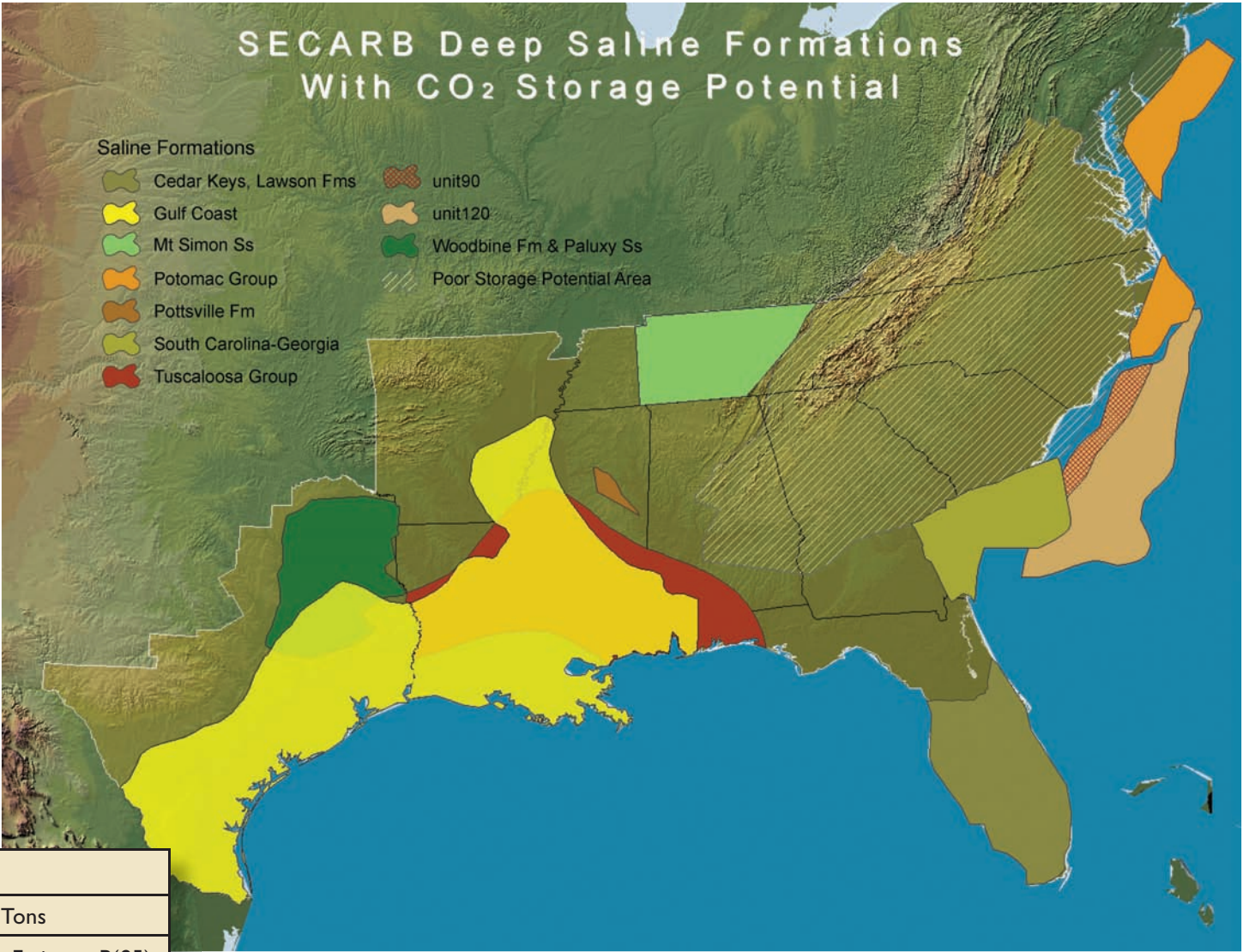
Diagram of CO₂ injection for enhanced CBM recovery.

SECARB Deep Saline Formations

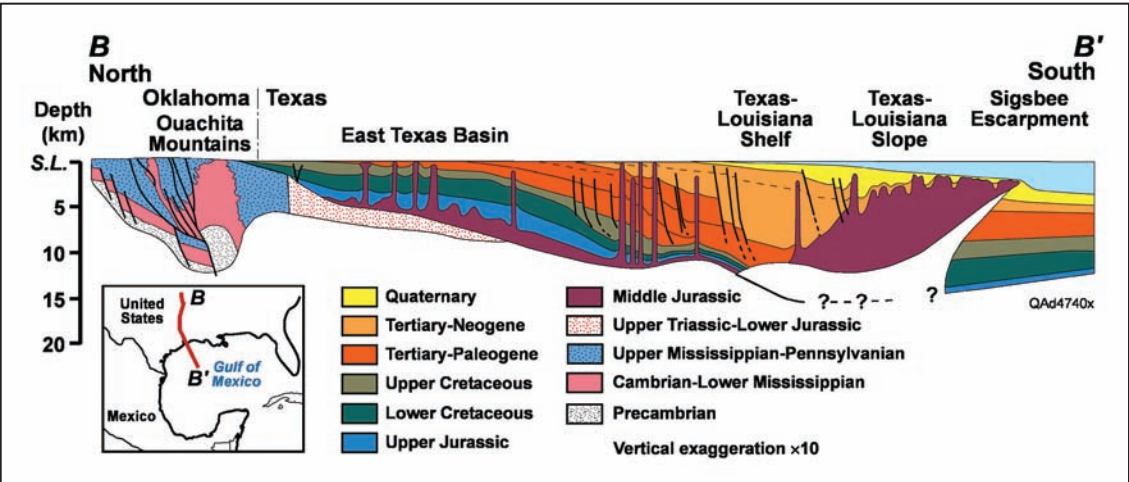
The Gulf Coast and interior salt basins in the SECARB Region provide numerous deep saline formations with large capacities for storing CO₂. These include the Upper Cretaceous Tuscaloosa Group in Alabama, Mississippi, and Louisiana; the Woodbine and Paluxy Formations of Texas; and the Mt. Simon Sandstone in Tennessee. In addition, considerable potential for geologic storage exists in subsea formations in the offshore Atlantic. An initial assessment suggests that these formations have the potential to store from 350–1,400 billion metric tons (390–1,500 billion tons) of CO₂.

Improved reservoir characterization, particularly full delineation of the internal architecture of these saline formations, are required for more precise estimates of CO₂ storage capacity.

Storage potential in the Appalachian Piedmont and Blue Ridge areas is poor to nonexistent because crystalline and metamorphic rocks at surface provide no predictable seal and have low porosity and permeability.

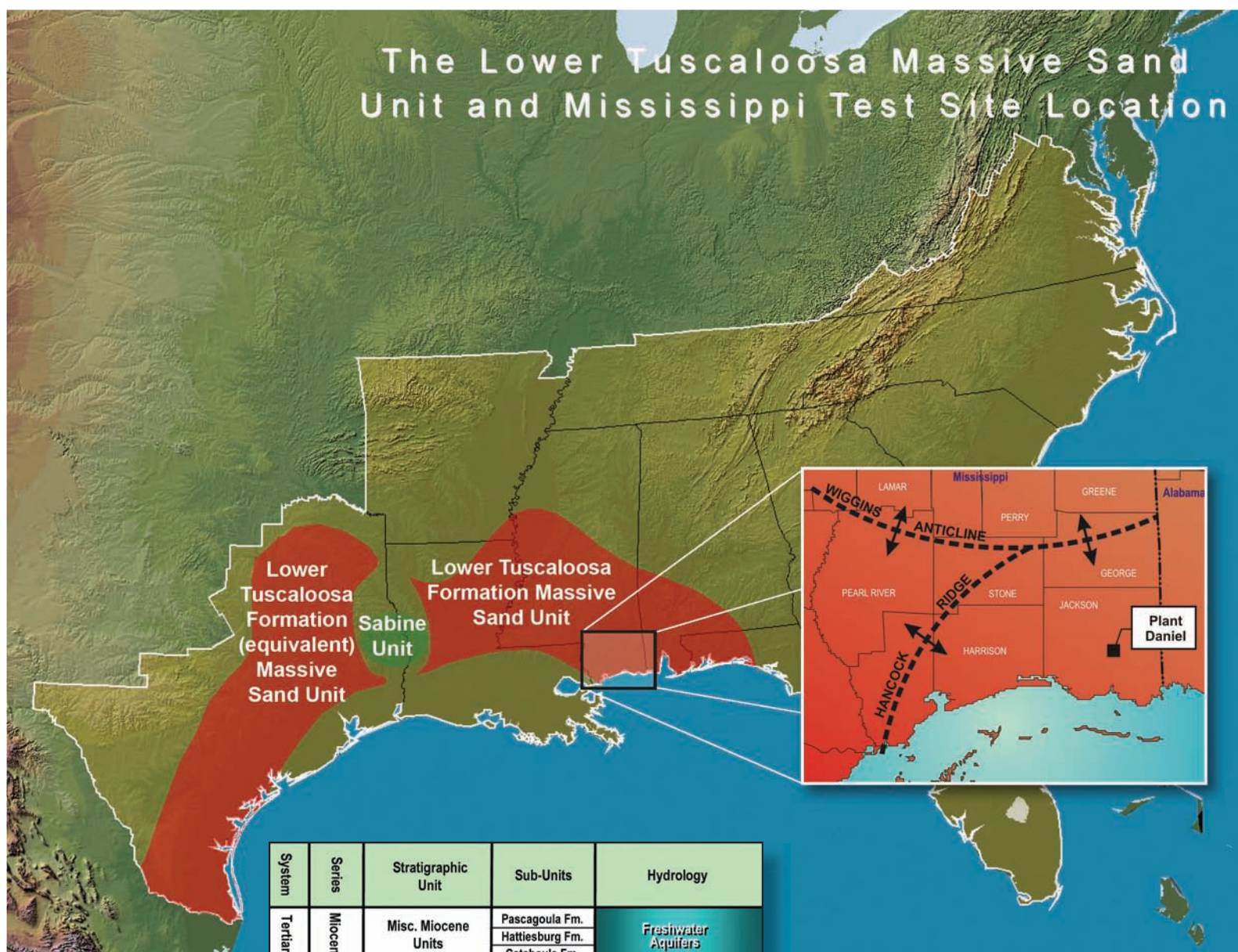


Saline Formations	CO ₂ Storage Capacity			
	Billion Cubic Feet (Bcf)		Million Metric Tons	
	High Estimate P(15)	Low Estimate P(85)	High Estimate P(15)	Low Estimate P(85)
Gulf Coast Basins	13,419,989	3,356,017	710,264	177,567
Tuscaloosa Group	813,456	203,364	43,040	10,760
Woodbine and Paluxy Formations	962,633	240,654	50,933	12,733
Pottsville Formation	210,414	52,599	11,133	2,783
Mt. Simon Sandstone	94,500	23,625	5,000	1,250
Potomac Group	88,376	222,094	47,004	11,751
South Carolina-Georgia Basins	597,070	149,272	31,591	7,898
Cedar Keys, Lawson Formations	2,098,694	524,683	111,042	27,761
Offshore Atlantic (Unit 120)	6,732,936	1,683,234	356,240	89,060
Offshore Atlantic (Unit 90)	586,656	146,664	31,040	7,760
Total	25,604,724	6,602,206	1,397,287	349,323



Geologic formations along the Gulf Coast.

The Lower Tuscaloosa Massive Sand Unit and Mississippi Test Site Location



System	Series	Stratigraphic Unit	Sub-Units	Hydrology
Tertiary	Miocene	Misc. Miocene Units	Pascagoula Fm.	Freshwater Aquifers
			Hattiesburg Fm.	
Cretaceous	Upper	Selma Chalk	Navarro Fm.	Confining unit
			Taylor Fm.	
		Eutaw	Austin Fm.	Confining unit
			Eagle Ford Fm.	Saline Reservoir
		Tuscaloosa Group	Upper Tusc.	Minor Reservoir
			Marine Tusc.	Confining unit
			Interbeds	Saline Reservoir
			Lower Tusc. Massive Sand	
	Lower	Washita – Fredricksburg	Dantzler Fm.	Saline Reservoir
			“Limestone Unit”	

SECARB Field Tests

Saline Formation Pilot Test

The Mississippi Test Site

The purpose of the project is to evaluate a major deep saline reservoir—the Massive Sand Unit of the Lower Tuscaloosa Formation along the Mississippi Gulf Coast—for geologic storage of CO₂. Mississippi Power Company’s Plant Daniel, a 2,000 MW facility near the town of Escatawpa, is the site for the CO₂ injection test. Initial study indicates that the Massive Sand Unit of the Lower Tuscaloosa Formation could hold 11–43 billion metric tons (12–47 billion tons) of CO₂, sufficient to store the CO₂ emissions from Plant Daniel and other power plants in the Region for decades. Deeper saline formations add considerable CO₂ storage capacity in this Region.



Mississippi Power Company’s Plant Daniel.

Stacked Storage Pilot Test

Gulf Coast Site

The Gulf Coast Stacked Storage project will demonstrate the concept of phased use of subsurface volumes, combining early use of CO₂ for EOR with later injection into underlying or adjacent brine formations. The benefits of this phased development are short-term, large-volume injection with immediate commercial benefit to support research and infrastructure development followed by use of underlying or adjacent brine-bearing formations for large volume, long-term storage. The Cranfield site in Southwest Mississippi has been selected for this test.



Coal Seam Pilot Test

Black Warrior Basin

The prolific coalbed methane industry in the Black Warrior Basin is approaching maturity. Coal in the Black Warrior Basin has the potential to sequester 1,020 to 2,100 million metric tons (1,120 to 2,320 million tons) of CO₂, and CO₂ ECBM recovery has the potential to prolong the life of the reservoirs and increase reserves by 20 to 40 percent. Two coal-fired power plants with combined CO₂ emissions exceeding 28 million metric tons/yr (31 million tons/yr) are located immediately to the north of the basin. The proximity of mature coalbed methane reservoirs to these plants may provide economic incentive for sequestration, depending on the cost of CO₂ capture from these facilities. Numerous conventional hydrocarbon reservoirs and saline reservoirs in the basin can help facilitate longer-term sequestration.



Coal Seam Pilot Test

Central Appalachian Basin

The most favorable areas delineated for the proposed Central Appalachian sequestration field test are located within the CBM production region in Buchanan, Dickenson, Russell, Tazewell, and Wise Counties, Virginia; and in Fayette, McDowell, Raleigh, and Wyoming Counties, West Virginia. CBM development in the area has provided extensive geologic, engineering, and production data, which will be made available for reservoir modeling. An assessment of sequestration capacity for southwestern Virginia indicates that there may be 742 million metric tons (818 million tons) of CO₂ storage capacity, with 279 million metric tons (308 million tons) deemed technically feasible for sequestration projects, available in the Region. The corresponding enhanced CBM recovery potential of these coals are 19–42 billion m³ (0.7–1.5 trillion ft³). Sources of CO₂ in the area are large coal-fired power plants that may be able to supply CO₂ for sequestration projects.

